QUALITATIVE ANALYSIS

SECTION A (40 Marks)

*Attempt **all** questions from this Section.*

Question 1

(a) Find the value of 'x' and 'y' if: [3]

$$2\begin{bmatrix} x & 7 \\ 9 & y-5 \end{bmatrix} + \begin{bmatrix} 6 & -7 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 10 & 7 \\ 22 & 15 \end{bmatrix}$$

(b) Sonia had a recurring deposit account in a bank and deposited ₹600 per month for 2½ years. If the rate of interest was 10% p.a., find the maturity value of this account. [3]

(c) Cards bearing numbers 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20 are kept in a bag. A card is drawn at random from the bag. Find the probability of getting a card which is: [4]

(i) a prime number.

(ii) a number divisible by 4.

(iii) a number that is a multiple of 6.

(iv) an odd number.

Comments of Examiners

(a) Some candidates made mistakes in:
- scalar multiplication of the matrix e.g., 2(y – 5) was written as 2y – 5 instead of 2y – 10.
- addition and equating corresponding elements of two matrices.

(b) A number of candidates made errors in determining the qualifying principal to find the interest and in finding the maturity value. Some candidates took 'n' as $2\frac{1}{2}$ years instead of 30 months. In calculating interest, some candidates took monthly installment as 60 x 30 = ₹18000 instead of ₹600. For finding matured value, some candidates added ₹600 and the interest.

(c) Many candidates considered the total outcomes as 20 instead of 10. Common errors made were:
(i) Some candidates did not consider '2' as a prime number.
(ii) In identifying multiples of 6, some left out 6.
(iii) Answers were not expressed in the simplest form.
(iv) $\frac{0}{10}$ was not expressed as 0.

Suggestions for teachers

- Give thorough practice of basic operations like addition, multiplication of matrices and solving matrix equation.
- Drill students with basic concepts like monthly installment, qualifying principal to find interest, and maturity value.
- Advise students to read the questions carefully. In such questions, ask them to first identify the total outcomes of the problem.
- Instruct students to express answers in the simplest form.
- Drill students with basic concepts like prime numbers, multiples of numbers, etc.

MARKING SCHEME

Question 1

(a)	$2\begin{bmatrix} x & 7 \\ 9 & y-5 \end{bmatrix} + \begin{bmatrix} 6 & -7 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 10 & 7 \\ 22 & 15 \end{bmatrix}$ $\begin{bmatrix} 2x & 14 \\ 18 & 2y-10 \end{bmatrix} + \begin{bmatrix} 6 & -7 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 10 & 7 \\ 22 & 15 \end{bmatrix}$ $\begin{bmatrix} 2x+6 & 14-7 \\ 18+4 & 2y-10+5 \end{bmatrix} = \begin{bmatrix} 10 & 7 \\ 22 & 15 \end{bmatrix}$ $\begin{bmatrix} 2x+6 & 7 \\ 22 & 2y-5 \end{bmatrix} = \begin{bmatrix} 10 & 7 \\ 22 & 15 \end{bmatrix}$ $\therefore 2x+6 = 10 \quad \boldsymbol{OR} \quad 2y-5 = 15$ $\therefore 2x = 10-6 \qquad 2y = 15+5$ $2x = 4 \quad \boldsymbol{OR} \quad 2y = 20$ $\therefore x = 2 \qquad \therefore y = 10$
(b)	Qualifying Sum = $\frac{600\ x\ 30\ x\ (30+1)}{2}$

	$Interest = \frac{600 \text{ x } 30 \text{ x } 31 \text{ x } 10}{2 \text{ x } 12 \text{ x } 100} = ₹2325$ $M.V. = 600 \text{ x } 30 + 2325 = ₹20325$
(c)	$2, 4, 6, 8, 10, 12, 14, 16, 18, 20$ Total number of cards are 10 (i) Probability of getting a prime number is $\frac{1}{10}$ (ii) Probability of getting a number divisible by 4: Numbers are 4, 8, 12, 16 and 20 $\therefore$ Probability = $\frac{5}{10} = \frac{1}{2}$ (iii) Multiples of 6 are 6, 12, 18. $\therefore$ Probability = $\frac{3}{10}$ (iv) No cards bear an odd number. $\therefore$ Probability = $\frac{0}{10} = 0$

Question 2

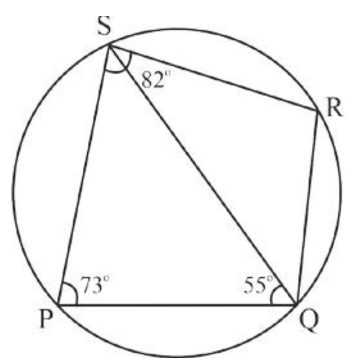
(a) The circumference of the base of a cylindrical vessel is 132 cm and its height is 25 cm. Find the [3]

(i) radius of the cylinder

(ii) volume of cylinder. (use $\pi = \frac{22}{7}$)

(b) If $(k - 3)$, $(2k + 1)$ and $(4k + 3)$ are three consecutive terms of an A.P., find the value of k. [3]

(c) PQRS is a cyclic quadrilateral. Given $\angle QPS = 73^o$, $\angle PQS = 55^o$ and $\angle PSR = 82^o$, calculate: [4]



(i) $\angle QRS$

(ii) $\angle RQS$

(iii) $\angle PRQ$

Comments of Examiners

(a) Some candidates applied incorrect formulas for finding out the radius of the cylinder, i.e., the circumference of the base of the cylinder was taken as πr^2 or $2\pi rh$ instead of $2\pi r$. Also, some used incorrect formula for finding the volume of the cylinder.

(b) The concept of Arithmetic Progression was not clear to many candidates. Many candidates were unable to identify the common difference 'd' hence, failed to equate the difference between second term and first term i.e., $t_2 - t_1$ and third term and second term i.e., $t_3 - t_2$ to evaluate 'k'. Some candidates equated second term of A.P. equal to the sum of third term and the first term i.e., $t_2 = t_3 + t_1$.

(c) Common errors identified in many scripts were as follows:

(i)Properties of circles like, angles in the same segment are equal, opposites angles of a cyclic quadrilateral are supplementary, etc. were not applied correctly.

(ii)Appropriate reasons supporting the answers were missing.

Suggestions for teachers

– Give adequate practice for application of various mensuration formulae to prevent students from getting confused between the formulae of volume and surface area of solids.

- Build the concept of series with various examples followed by generalizing the first term of the series, the rule governing the consecutive terms of the series. Thus, develop the common difference of an A.P. and the summation of a given number of terms of the series.

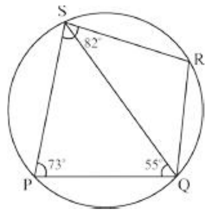
- Emphasise on giving reasons supporting each answer while solving geometry problems. Drill students in naming angles correctly.

MARKING SCHEME

Question 2

(a)	$2\pi\, r = 132$ $r = 21cm$ $V = \pi\, r^2 h = \frac{22.21.21.25}{7} = 34650\ cm^3$
(b)	$(k-3), (2k+1), (4k+3)$ $k-3, 2k+1, 4k+3$ in AP implies $(2k+1)-(k-3) = (4k+3)-(2k+1)$ $\therefore\ 2k+1-k+3 = 4k+3-2k-1$ $k+4 = 2k+2$ $\therefore\ 2k-k = 4-2\ or\ k = 2$

(c)



(i) $\angle QRS = 180^\circ - 73^\circ = 107^\circ$ (opposite angles of a cyclic quadrilateral are supplementary)

(ii) $\angle RQS = 180 - (82^\circ + 55^\circ)$

$= 180 - 137$

$= 43^\circ$

(iii) $\angle PSQ = 180^\circ - (73^\circ + 55^\circ)$

$= 52^\circ$

$\therefore \angle PRQ = \angle PSQ = 52^\circ$ ($\angle$s in the same segment are equal)

Question 3

(a) If $(x + 2)$ and $(x + 3)$ are factors of $x^3 + ax + b$, find the values of 'a' and 'b'. [3]

(b) Prove that $\sqrt{sec^2\theta + cosec^2\theta} = tan\theta + cot\theta$ [3]

(c) Using a graph paper draw a histogram for the given distribution showing the number of runs scored by 50 batsmen. Estimate the mode of the data: [4]

Runs scored	3000-4000	4000-5000	5000-6000	6000-7000	7000-8000	8000-9000	9000-10000
No. of batsmen	4	18	9	6	7	2	4

Comments of Examiners

(a) Some candidates made mistakes in substituting x = - 2 or x = - 3 in solving the two equations formed to find ***a*** and ***b***. A few candidates substituted the factors of the given polynomial correctly but failed to equate them to zero at the time of calculation.

(b) In solving identities, some candidates squared the identity either on one side or both sides before proceeding for proving the identity. Many candidates were unable to use identities like $\sec^2\theta = 1 + \tan^2\theta$ etc. Some solved the two sides of the identity simultaneously or interchanged terms from one side to the other.

(c) Some common errors related to the problem were as follows:
- Incorrect choice of scale.
- As the data (runs scored), was from 3000 – 4000, some candidates did not put a kink to explain the gap between origin and the first number.
- Bars drawn by a few candidates were not of equal width.
- Some candidates plotted the graph with cumulative frequency instead of frequency.
- Method of identification of Mode from graph was incorrect.
- Many candidates took the reading from the graph as 4006 instead of 4600.

Suggestions for teachers

- Insist that students should strictly follow the instructions given in all questions.
- Give ample practice to solve the problems based on Remainder and Factor Theorem.
- Give sufficient revision of simultaneous equations to the students so that they can apply the concept in other topics wherever it is required.
- Advise students to prove identities with one side at a time instead of working with both sides together. Adequate drilling is essential with trigonometric identities.
- Clarify the rules of plotting graphs thoroughly to the students. Method to locate mode need sufficient practice.

MARKING SCHEME

Question 3

(a) $(x + 2)$ and $(x + 3)$ factors → $x^3 + ax + b$

$f(-2) = (-2)^3 + a(-2) + b$ $\qquad$ $f(-3) = (-3)^3 + a(-3) + b$

$\therefore 0 = -8 - 2a + b \Rightarrow -2a + b = 8$ $\qquad$ $0 = -27 - 3a + b \Rightarrow -3a + b = 27$

$-2a + b = 8$

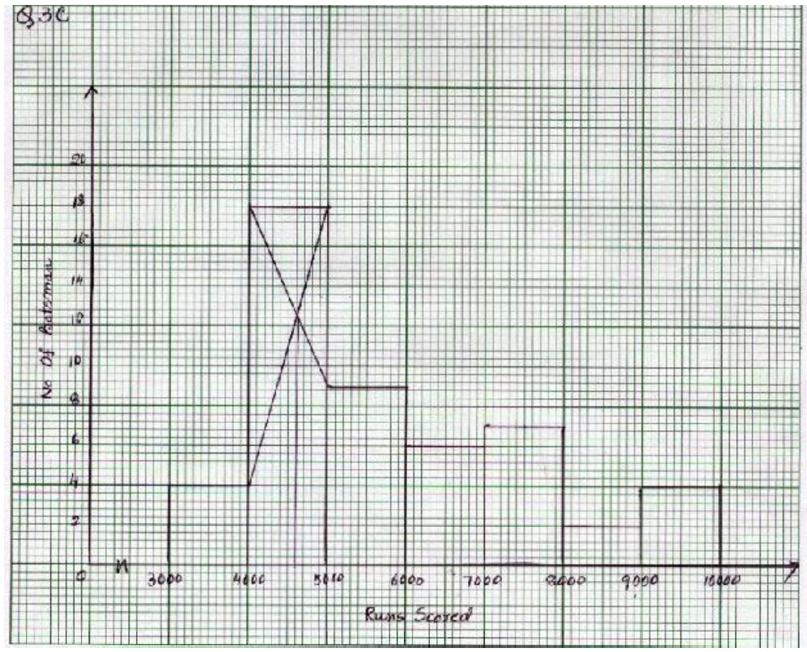
$-3a + b = 27$

$+ \quad - \quad -$

$a = -19$

$38 + b = 8$

$b = -30$

(b)	$LHS = \sqrt{sec^2\theta + cosec^2\theta} = \sqrt{1 + tan^2\theta + 1 + cot^2\theta}$ $= \sqrt{tan^2\theta + cot^2\theta + 2} = \sqrt{(tan\theta + cot\theta)^2} = tan\theta + cot\theta = RHS$ (Using any one identity correctly)
(c)	Mode = 4600 runs Axis and Scale: On X axis: 2 cm = 1000 runs On Y axis: 2 cm = 4 batsmen 

Question 4

(a) Solve the following inequation, write down the solution set and represent it on the real number line: [3]

$$-2 + 10x \leq 13x + 10 < 24 + 10x, x \in Z$$

(b) If the straight lines $3x - 5y = 7$ and $4x + ay + 9 = 0$ are perpendicular to one another, find the value of a. [3]

(c) Solve $x^2 + 7x = 7$ and give your answer correct to two decimal places. [4]

Comments of Examiners

(a) Many candidates made errors in transposing like terms on same side. Some candidates made mistakes in solving the inequation. Most of the errors were pertaining to positive and negative signs. A number of candidates did not write down the solution set after solving the given inequation. Representation on number line was incorrect due to the following reasons: -
-3x ≤ 12 was simplified and written as 3x ≤ -12 instead of 3x ≥ -12. Some candidates took x ∈ R instead of x ∈ Z; others drew the number line without arrows. A few candidates failed to put extra number on each side of solution for indicating the continuity of the number line.

(b) Many candidates could not find the correct slope of the two lines. Some candidates used the perpendicular condition $m_1 m_2 = -1$ incorrectly. Quite a few made calculation errors.

(c) Common errors made by candidates were:
- use of incorrect formula.
- mistakes in arranging the equation in standard quadratic equation form.
- mistakes in calculation.
- errors in finding square root of √77.
- not writing the answer correct up to two decimal places or not rounding off at all.

Suggestions for teachers

- Give thorough practice on using positive and negative signs.
- Drill thoroughly in writing the solution set after solving the inequation and with representation of the same on the number line. Familiarise students with the symbols *Z, N, I, W* and *R*.
- Give adequate practice in finding the slope of a line from a given equation. Also drill students about the use of conditions for slope of two parallel lines/ perpendicular lines.
- Encourage students to use Mathematical tables to find square roots of numbers.
- Rigorous drilling is necessary on approximation so that candidates are able to round off as required in the question.

MARKING SCHEME

Question 4

(a)

$-2 + 10x \le 13x + 10 < 24 + 10x$

$-2 + 10x \le 13x + 10 \qquad\qquad 13x + 10 < 24 + 10x$

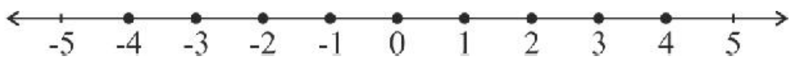
$10x - 13x \le 10 + 2 \qquad\qquad 13x - 10x < 24 - 10$

$-3x \le 12 \qquad or \qquad 3x < 14$

$3x \ge -12 \qquad\qquad x < \dfrac{14}{3}$

$\therefore x \ge -4 \qquad\qquad x < 4\dfrac{2}{3}$

Solution: {-4, -3, -2, -1, 0, 1, 2, 3, 4}



(b)

$3x - 5y = 7 \;\Rightarrow\; y = \dfrac{3}{5}x - \dfrac{7}{5} \qquad \therefore slope\ m_1 = \dfrac{3}{5}$

$4x + ay + 9 = 0 \Rightarrow y = -\dfrac{4}{a}x - \dfrac{9}{a}$

$\therefore\ slope\ m_2 = -\dfrac{4}{a}$

$\therefore \left(\dfrac{3}{5}\right)\left(-\dfrac{4}{a}\right) = -1 \Rightarrow a = \dfrac{12}{5}$

(c)

$x^2 + 7x = 7 \Rightarrow x^2 + 7x - 7 = 0$

$a = 1, b = 7, c = -7$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-7 \pm \sqrt{(-7)^2 - 4 \times 1 \times (-7)}}{2 \times 1}$$

$$x = \frac{-7 \pm \sqrt{49 + 28}}{2 \times 1} = \frac{-7 \pm \sqrt{77}}{2}$$

$$= \frac{-7 \pm 8.775}{2}$$

$$= \frac{-7 + 8.775}{2}, \qquad \frac{-7 - 8.775}{2}$$

$$\frac{1.775}{2}, \qquad \frac{-15.775}{2}$$

$= 0.8875, \qquad -7.8875$

$x = \{0.89, -7.89\}$

SECTION B (40 Marks)

*Attempt any **four** questions from this Section*

Question 5

(a) The 4^{th} term of a G.P. is 16 and the 7^{th} term is 128. Find the first term and common ratio of the series. [3]

(b) A man invests ₹22,500 in ₹50 shares available at 10% discount. If the dividend paid by the company is 12%, calculate: [3]

(i) The number of shares purchased

(ii) The annual dividend received.

(iii) The rate of return he gets on his investment. Give your answer correct to the nearest whole number.

(c) Use graph paper for this question (Take 2 cm = 1unit along both x and y axis). ABCD is a quadrilateral whose vertices are A (2,2), B (2, –2), C (0,–1) and D(0,1). [4]

(i) Reflect quadrilateral ABCD on the y-axis and name it as A'B'CD.

(ii) Write down the coordinates of A' and B'.

(iii) Name two points which are invariant under the above reflection.

(iv) Name the polygon A'B'CD.

Comments of Examiners

(a) Several candidates went wrong in calculation. Some candidates tried solving the problem as an A.P. instead of G.P. A few candidates took $\sqrt[3]{8}$ as +2 and -2 instead of only +2. Some candidates tried the sum by trial method by assuming a =2 and r =2.

(b) Many candidates calculated the discounted market value incorrectly hence, annual dividend calculated was also incorrect.

A number of candidates did not round off the yield percent to the nearest whole number as it was asked in the question.

(c) Common errors observed were:

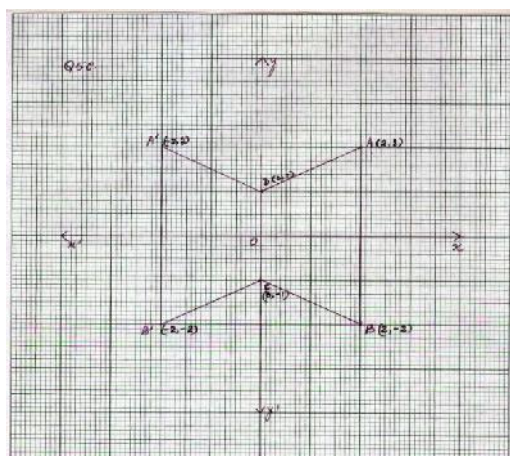
- labelling /choice of axes was incorrect;
- plotting the points A′ and B′ was correct but their coordinates were not written;
- plotting of points (1,0) and (0,1) was incorrect;
- the figure was named as *trapezium* instead of *isosceles trapezium*.

Suggestions for teachers

- Instruct students to read the question heedfully and analyze the given conditions before solving the problem. Give them the clear understanding of the concept of common difference and common ratio so as to avoid mixing up sums on A.P. and G.P.
- Stress upon solving sums using given conditions and not by trial method.
- Ensure that students understand the meaning of the terms *shares at par*, *at premium*, *at a discount*, *nominal value(N.V.)*, *market value(M.V.) and dividend*, etc. clearly. The concept of approximation of result needs thorough drilling.
- Instruct students strictly that after plotting necessary points, their coordinates must also be written. The figure formed must be completed. Names of basic geometrical figures need to be revised. Give students clear idea of invariant points. Drilling of plotting points on x-axis and y-axis is essential.

MARKING SCHEME

Question 5

(a)	Let a be the first term and r the common ratio and $T_4 = 16$, $T_7 = 128$ $\therefore\ a\,r^{4-1} = 16$ and $a\,r^{7-1} = 128$ $a\,r^3 = 16$ $\qquad$ $a\,r^6 = 128$ $\dfrac{a\,r^6}{a\,r^3} = \dfrac{128}{16}$ $\qquad$ $\therefore\ r^3 = 8 = 2^3$ $\therefore\ r = 2$ $ar^3 = 16 \Rightarrow a \times 2^3 = 16$ $\therefore\ a = 2$
(b)	NV = 50 MV= 50 – 10% of 50= 45 (i) Number of shares = $\frac{22500}{45} = 500$ (ii) Annual dividend = $\frac{12x50x500}{100} = 3000$ (iii)Yield% = $\frac{3000}{22500} \times 100 = 13.333\% \approx 13\%$
(c)	(i) Quadrilateral A’B’CD marked on graph sheet (ii) A'(–2, 2) and B'(–2, –2) (iii) C and D (iv) Isosceles trapezium 

Question 6

(a) Using properties of proportion, solve for x. Given that x is positive: [3]

$$\frac{2x+\sqrt{4x^2-1}}{2x-\sqrt{4x^2-1}}=4$$

(b) $If\ A=\begin{bmatrix}2 & 3\\5 & 7\end{bmatrix}, B=\begin{bmatrix}0 & 4\\-1 & 7\end{bmatrix}\ and\ C=\begin{bmatrix}1 & 0\\-1 & 4\end{bmatrix}$, find AC + B^2 – 10C. [3]

(c) Prove that $(1+\cot\theta\ -\ cosec\theta)(1+tan\theta+sec\theta)=2$ [4]

Comments of Examiners

(a) Many candidates solved the problem without using properties of proportion. Some candidates applied componendo and dividendo but made mistakes in squaring both sides. Quite a few candidates did not follow the instruction for expressing the value of x. They expressed x as $\pm\frac{5}{8}$ instead of $\frac{5}{8}$.

(b) Some candidates found B^2 by squaring each element of matrix B instead of finding matrix product B X B. A few candidates made mistakes in finding the scalar multiplication -10 C.

(c) A number of candidates made mistakes while multiplying the two expressions on the Left-Hand Side of the question. A few candidates worked upto $\left(1+\frac{cos\theta}{sin\theta}-\frac{1}{sin\theta}\right)\left(1+\frac{sin\theta}{cos\theta}-\frac{1}{cos\theta}\right)$.
but could not take LCM and simplify. Some were unable to simplify by applying algebraic identity (a + b)(a – b) = a^2-b^2, hence, could not get the correct answer.

Suggestions for teachers

- Advise students to read the question meticulously to avoid errors such as not using properties of proportion.
- Drill previously learnt concepts of algebraic addition, multiplication and applying algebraic identities to square expressions.
- Give sufficient practice in application of properties of proportion.
- Give thorough drilling exercises with matrix multiplication. Stress upon finding square of a matrix. Basic operations with matrix addition and scalar multiplication need repeated practice.
- Give ample practice on basic algebraic operations and identities to enable students to simplify trigonometric identities.
- Revise basic trigonometry formulae on a regular basis in the class.

MARKING SCHEME

Question 6

(a)

$$\frac{2x+\sqrt{4x^2-1}}{2x-\sqrt{4x^2-1}} = 4$$

By using the property Componendo & Dividendo

$$\frac{2x+\sqrt{4x^2-1}+2x-\sqrt{4x^2-1}}{2x+\sqrt{4x^2-1}-2x-\sqrt{4x^2-1}} = \frac{4+1}{4-1}$$

$$\Rightarrow \frac{4x}{2\sqrt{4x^2-1}} = \frac{5}{3} \Rightarrow \frac{2x}{\sqrt{4x^2-1}} = \frac{5}{3}$$

Squaring both sides

$$\frac{4x^2}{4x^2-1} = \frac{25}{9}$$

$$\Rightarrow 36x^2 = 100x^2 - 25$$

$$\Rightarrow 65x^2 = 25 \Rightarrow x^2 = \frac{25}{64} \Rightarrow x = \pm\frac{5}{8} \ \therefore\ x = \frac{5}{8}$$

(b)

$$AC + B^2 - 5C = \begin{bmatrix}2 & 3\\5 & 7\end{bmatrix}\begin{bmatrix}1 & 0\\-1 & 4\end{bmatrix} + \begin{bmatrix}0 & 4\\-1 & 7\end{bmatrix}\begin{bmatrix}0 & 4\\-1 & 7\end{bmatrix} - 10\begin{bmatrix}1 & 0\\-1 & 4\end{bmatrix}$$

$$= \begin{bmatrix}2-3 & 0+12\\5-7 & 0+28\end{bmatrix} + \begin{bmatrix}0-4 & 0+28\\0-7 & -4+49\end{bmatrix} - \begin{bmatrix}10 & 0\\-10 & 40\end{bmatrix}$$

$$= \begin{bmatrix}-1 & 12\\-2 & 28\end{bmatrix} + \begin{bmatrix}-4 & 28\\-7 & 45\end{bmatrix} - \begin{bmatrix}10 & 0\\-10 & 40\end{bmatrix} = \begin{bmatrix}-5 & 40\\-9 & 73\end{bmatrix} - \begin{bmatrix}10 & 0\\-10 & 40\end{bmatrix} = \begin{bmatrix}-15 & 40\\1 & 33\end{bmatrix}$$

(c)

$$(1+cot\theta - cosec\theta)(1+tan\theta + sec\theta) = 2$$

$$\left(\frac{1}{1}+\frac{cos\theta}{sin\theta}-\frac{1}{sin\theta}\right)\left(\frac{1}{1}+\frac{sin\theta}{cos\theta}+\frac{1}{cos\theta}\right)$$

$$\left(\frac{sin\theta+cos\theta-1}{sin\theta}\right)\ \left(\frac{cos\theta+sin\theta+1}{cos\theta}\right) \qquad (a+b)(a-b) = a^2-b^2$$

OR

$$= \frac{(sin\theta+cos\theta)^2-(1)^2}{sin\theta cos\theta} = \frac{sin^2\theta+cos^2\theta+2sin\theta cos\theta-1}{sin\theta cos\theta}$$

$$= \frac{\cancel{1}+2sin\theta cos\theta-\cancel{1}}{sin\theta cos\theta} = \frac{2\cancel{sin\theta cos\theta}}{\cancel{sin\theta cos\theta}} = 2$$

Question 7

(a) Find the value of k for which the following equation has equal roots. [3]

$$x^2 + 4kx + (k^2 - k + 2) = 0$$

(b) On a map drawn to a scale of 1:50,000, a rectangular plot of land ABCD has the following dimensions. AB = 6 cm; BC = 8 cm and all angles are right angles. Find: [3]

(i) the actual length of the diagonal distance AC of the plot in km.

(ii) the actual area of the plot in square km.

(c) A (2, 5), B (–1, 2) and C (5, 8) are the vertices of a triangle ABC, 'M' is a point on AB such that AM: MB = 1: 2. Find the co-ordinates of 'M'. Hence find the equation of the line passing through the points C and M. [4]

Comments of Examiners

(a) Some candidates were not clear about the nature of roots of Quadratic Equation. Majority of candidates found the discriminant $(4k)^2 - 4(k^2 - k + 2)$ correctly but did not equate it to 0 as per the condition of equal roots. Some candidates took x along with coefficient to find discriminant. A few candidates made errors in solving the equation $12k^2 + k - 8 = 0$ to find the value of k.

(b) Many candidates were not clear about the phrase *map drawn to a scale*.... A number of candidates made calculation errors. A few candidates made mistakes in unit conversion i.e., cm^2 to km^2.

(c) Several candidates used midpoint formula to find M instead of using section formula. Some candidates used section formula but made mistakes in substitution. Quite a few candidates found the values of x and y of M correctly but did not write the answer in the coordinate form. With the value of slope found being incorrect, equation of the required line was also incorrect.

Suggestions for teachers

- Stress upon the understanding of nature of roots and use of coefficient of x^2, x and constant, c for finding out the discriminant. Adequate practice could help in solving such problems.
- Give thorough practice in units and conversion of units to solve sums on maps and models. Also give adequate practice on size transformation and proportionality.
- Train students to express the points in coordinate geometry in coordinate form. Thorough drilling of section formula is necessary. Ensure that sufficient practice is given in finding slope of line and its equation using different methods.

MARKING SCHEME

Question 7

(a) Given equation is $x^2 + 4kx + (k^2 - k + 2) = 0$

For equal roots discriminant = 0

$\therefore (4k)^2 - 4(k^2 - k + 2) = 0$

$16k^2 - 4k^2 + 4k - 8 = 0$

$12k^2 + 4k - 8 = 0$

$3k^2 + k - 2 = 0 \Rightarrow 3k^2 + 3k - 2k = 0$

$3k(k + 1)(3k - 2) = 0$

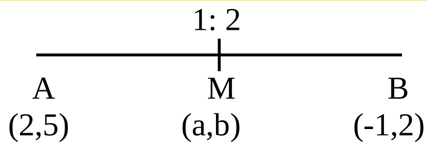
$\therefore k = -1, k = 2/3$

(b) AB = 6, BC = 8, Diagonal AC = $\sqrt{6^2 + 8^2} = 10$

(i) $\frac{10\times 50000}{1000} = 5\ km$

(ii) $\frac{6\times 8\times 50000\times 50000}{(100000)^2} = 12\ sq\ km$

(c)



$$a = \frac{1\times -1 + 2\times 2}{1+2} \qquad b = \frac{1\times 2 + 2\times 5}{1+2}$$

$$a = \frac{-1+4}{3} = \frac{3}{3} = 1 \qquad b = \frac{2+10}{3} = \frac{12}{3} = 4$$

Co-ordinates of M (1,4)

Equation of MC:

M (1,4)   C (5,8)

Slope = $\frac{8-4}{5-1} = \frac{4}{4} = 1$

$\therefore$ Equation is:

$y - 4 = 1\,(x - 1)$

$y - 4 = x - 1$

or $x - y + 3 = 0$

Question 8

(a) ₹7500 were divided equally among a certain number of children. Had there been 20 less children, each would have received ₹100 more. Find the original number of children. [3]

(b) If the mean of the following distribution is 24, find the value of '*a*'. [3]

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
Number of students	7	*a*	8	10	5

(c) Using ruler and compass only, construct a ΔABC such that BC = 5 cm and AB = 6.5 cm and ∠ABC = 120° [4]

(i) Construct a circum-circle of ΔABC

(ii) Construct a cyclic quadrilateral ABCD, such that D is equidistant from AB and BC.

Comments of Examiners

(a) Most candidates made mistakes in formulating the equation. Due to lack of concept on fractions some candidates formed the equation $\frac{7500}{x} - \frac{7500}{x-20} = 100$ instead of $\frac{7500}{x-20} - \frac{7500}{x} = 100$ Some were unable to factorize the equation correctly.

(b) Many candidates wrote incorrect Class mark of the given distribution. Hence, $\sum fx$ found was also incorrect. A few candidates wrote $\sum f$ as 30a instead of 30 + a and $\sum fx$ *was written as* $825a$ instead of 810 + 15a. Some made mistakes in applying the formula for mean and solving the equation to find 'a'.

(c) (i) Several candidates constructed triangle ABC with ∠ABC = 60° instead of 120°.

(ii) Quite a few candidates constructed circumcircle without bisecting two sides of the triangle so as to locate the circumcentre.

Suggestions for teachers

- In fractions, train students to differentiate which is greater or smaller.
- Train students to calculate mean involving unknown variables. Give them an understanding of finding class mark of grouped distribution. Revise basic concepts of algebraic operations.
- Give adequate practice of locus and geometrical properties. Advise students to show clearly all traces of construction using ruler and compass, while constructing geometrical figures.

(iii) Many candidates could not locate D, a point lying on the circle and bisector of ∠B. Hence could not complete the required quadrilateral.

MARKING SCHEME

Question 8

(a) Let the original number of children be x.

$\therefore$ each one gets $\frac{7500}{x}$

When 20 children less, each would get $\frac{7500}{x-20}$

$$\frac{7500}{x-20} - \frac{7500}{x} = 100$$

$\Rightarrow x^2 - 20x - 1500 = 0$

$\Rightarrow (x-50)(x+30) = 0$

$\therefore x = 50$

(b)

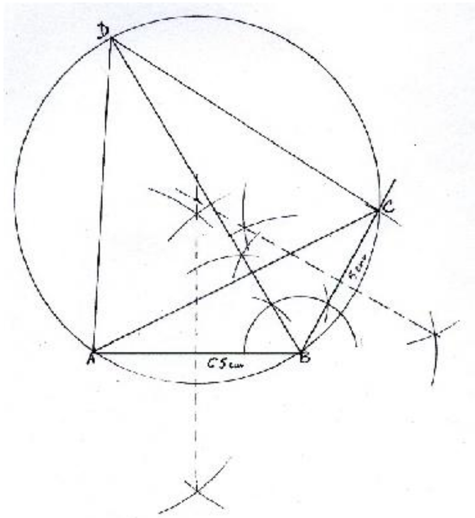
Marks	No. of Students(f)	x	fx
0 – 10	7	5	35
10 – 20	a	15	$15a$
20 – 30	8	25	200
30 – 40	10	35	350
40 – 50	5	45	225
	$\Sigma f = 30 + a$		$810 + 15a$

$Mean = \frac{\Sigma fx}{\Sigma f}$, $\frac{810+15a}{30+a} = 24$

$\therefore 810 + 15a = 720 + 24a$

$\therefore 810 - 720 = 24a - 15a$

$90 = 9a \therefore a = 10$

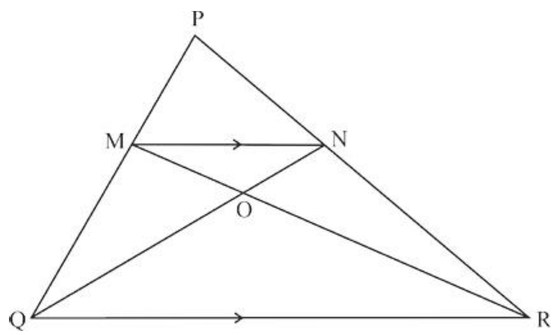
(c)	Construction of ΔABC Construction of side bisectors of sides AB and BC and draw circle Angle bisector of angle B Cyclic quadrilateral ABCD 

Question 9

(a) Priyanka has a recurring deposit account of ₹1000 per month at 10% per annum. If she gets ₹5550 as interest at the time of maturity, find the total time for which the account was held. [3]

(b) In ΔPQR, MN is parrallel to QR and [3]

$$\frac{PM}{MQ} = \frac{2}{3}$$

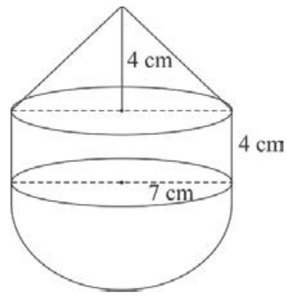


(i) Find $\frac{MN}{QR}$

(ii) Prove that ΔOMN and ΔORQ are similar.

(iii) Find, Area of ΔOMN : Area of ΔORQ

(c) The following figure represents a solid consisting of a right circular cylinder with a hemisphere at one end and a cone at the other. Their common radius is 7 cm. The height of the cylinder and cone are each of 4 cm. Find the volume of the solid. [4]



Comments of Examiners

(a) Many candidates considered ₹5550 as maturity value instead of interest. Some candidates got the correct equation $n^2 + n - 1332 = 0$, but were unable to factorize it correctly, hence, could not find 'n'.

(b) (i) A number of candidates were unable to prove Δ OMN ~ Δ ORQ

(ii) Δ OMN: Δ ORQ = 4:25 was written as $\frac{4}{25}$ hence many candidates went wrong with the answer.

(c) Many candidates did not read the question carefully and took the radius as $\frac{7}{2}$ instead of '7'. Some candidates made mistakes in applying the correct formula while a few made mistakes in calculation, especially those who used the value of $\pi = 3.14$

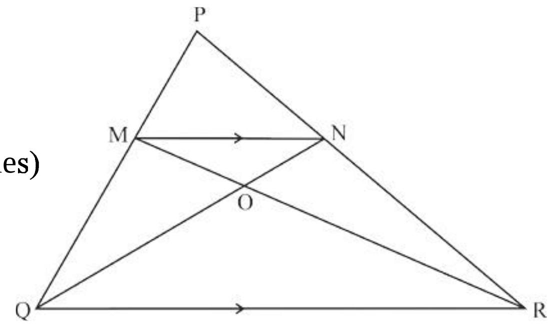
Suggestions for teachers

- Instruct students to read the question paper carefully to avoid making errors. e.g. taking ₹5550 as maturity value instead of interest. Stress upon revising middle term breakup factorization.
- More practice should be given to build up the concept of similarity and related results.
- Give sufficient practice in problems based on volume and surface area of different solids. Also teach students shorter methods of solving such problems instead of calculating each volume separately and then adding up.

MARKING SCHEME

Question 9

(a)	Monthly Deposit = ₹1000, rate of interest 10% Total interest = ₹5550 Let *n* be the number of months $\therefore 5550 = \dfrac{1000 \times n(n+1) \times 10}{100 \times 2 \times 12}$

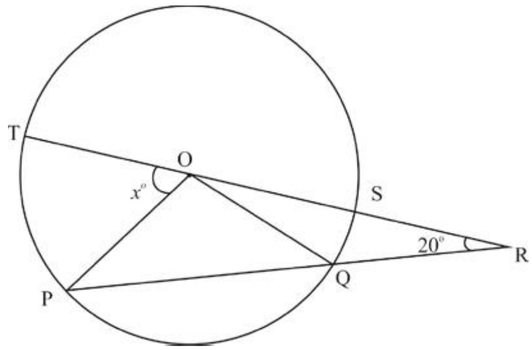
	$\frac{555 \times 24}{10} = n^2 + n \ \ or$ $n^2 + n - 1332 = 0$ $(n + 37)(n - 36) = 0$ $\therefore n = 36$ months i.e. $n = 3$ years
(b)	Proving ΔPMN ~ ΔPQR (i) $\frac{\text{MN}}{\text{QR}} = \frac{2}{5}$ (ii) ∠MON = ∠QOR (vertically opposite angles) ∠MNO = ∠OQR (alternate angles) ∠NMO = ∠ORQ (3rd angle) (iii) *ar* ΔOMN: *ar* ΔORQ = 4 : 25 
(c)	Volume = Volume of hemisphere + volume of cylinder + volume of cone $Volume \ = \frac{2}{3}\pi r^3 + \pi r^2 h + \frac{1}{3}\pi r^2 h$ $= \frac{\pi r^2}{3}[2r + 3h + h]$ $= \frac{22 \times 7^2}{7 \times 3}[2 \times 7 + 4 \times 4]$ $= \frac{22 \times 7}{3}[14 + 16]$ $= \frac{22 \times 7}{3} \times 30 = 1540 \ cm^2$

Question 10

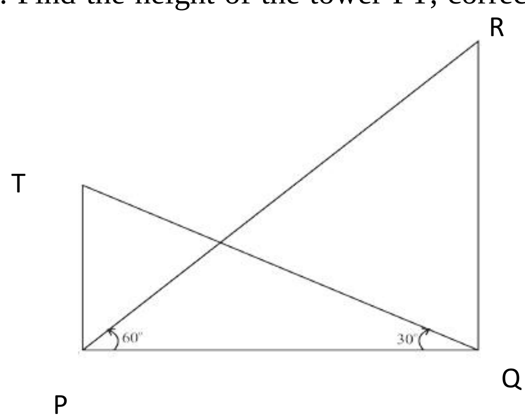
(a) Use Remainder theorem to factorize the following polynomial: [3]

$2x^3 + 3x^2 - \ 9x - 10.$

(b) In the figure given below 'O' is the centre of the circle. If QR = OP and ∠ORP = 20°. Find the value of 'x' giving reasons. [3]



(c) The angle of elevation from a point P of the top of a tower QR, 50 m high is 60^{o} and that of the tower PT from a point Q is 30^{o}. Find the height of the tower PT, correct to the nearest metre. [4]



Comments of Examiners

(a) Some candidates did not use Remainder theorem to identify the first factor as specified in the question. Some made mistakes in finding out the quotient by dividing the given polynomial by the factor found using factor theorem. Many candidates did not write the answer in the product form. e.g. $(x-2)(2x+5)(x+1)$

(b)A number of candidates could not identify the isosceles triangles OPQ and QOR. Some candidates could neither find the unknown angles, nor find the value of x. Reasons supporting the calculated result were either not given or given incorrect.

(c) Some candidates interchanged the values of tan 60° and tan 30° in the solution of the problem i.e., substituted the opposite of the correct values. Some made calculation errors. A few candidates did not round off the height of the tower to the nearest metre as per the requirement of the question.

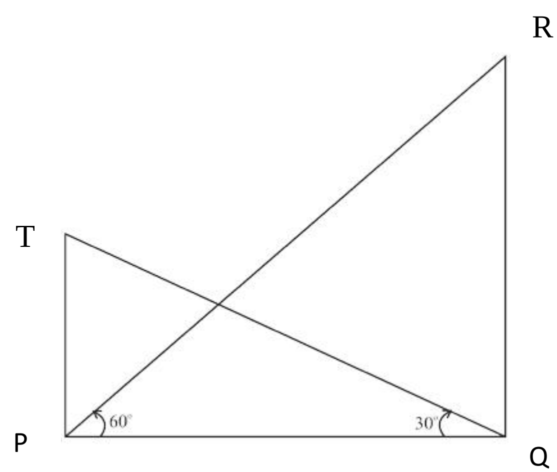
Suggestions for teachers

- Instruct students to read the instruction given in the question carefully e.g., using remainder and factor theorem. Also guide them to express the final answer as the product of the factors obtained.
- Give more practice in properties of circles to enable students to solve problems based on circles. Importance of giving reasons to geometrical problems must be made clear to all students.
- More drilling is necessary in problems based on Heights and Distances.
- Instruct students to give the final answer in the correct form, as asked in the question.

MARKING SCHEME

Question 10

(a)	$f(x) = 2x^3 + 3x^2 - 9x - 10$ $2x^3 + 3x^2 - 9x - 10$ $= 2 \times 2^3 + 3 \times 2^2 - 9 \times 2 - 10$ (Putting $x = 2$) $= 16 + 12 - 10 - 10$ $= 0 \therefore (x-2)$ is a factor $2x^3 + 3x^2 - 9x - 10 = (x-2)(2x^2 + 7x + 5)$ $= (x-2)(2x+5)(x-2)$

(b)	$\because OP = OQ \quad (radii\ of\ circle)$ $and\ OP = QR \quad (given)$ $\therefore OP = OQ = QR$ $In\ \Delta OQR, \quad OQ = QR$ $\therefore \angle \mathrm{ORQ} = \angle \mathrm{ROQ} = 20°$ $ext. \angle \mathrm{OQP} = 20° + 20° = 40°$ (exterior angle = sum of 2 interior opposite angles) $In\ \Delta OPQ, OP = OQ$ (radii) $\therefore \angle \mathrm{OPQ} = \angle \mathrm{OQP} = 40°$ $In\ \Delta OPR, ext\ \angle \mathrm{POT} = \angle \mathrm{OPR} + \angle \mathrm{ORP} = 40° + 20° = 60°$
(c)	In ΔPQR, $tan60° = \frac{QR}{PQ} = \frac{50}{PQ} \Rightarrow PQ = \frac{50}{\sqrt{3}}$ In ΔPQT, OR $tan30° = \frac{PT}{PQ} \Rightarrow \frac{1}{\sqrt{3}} = \frac{PT}{50/\sqrt{3}}$ $\Rightarrow PT = \frac{50}{3} = 16.66$ = 17 m (rounded to nearest metre) $tan60 = \sqrt{3} \quad OR \quad tan30 = \frac{1}{\sqrt{3}}$ PT = 17 m 

Question 11

(a) The 4^{th} term of an A.P. is 22 and 15^{th} term is 66. Find the first term and the common difference. Hence find the sum of the series to 8 terms. [4]

(b) Use Graph paper for this question. [6]

A survey regarding height (in cm) of 60 boys belonging to Class 10 of a school was conducted. The following data was recorded:

Height in cm	135 – 140	140 – 145	145 – 150	150 – 155	155 – 160	160 – 165	165 – 170
No. of boys	4	8	20	14	7	6	1

Taking 2 cm = height of 10 cm along one axis and 2 cm = 10 boys along the other axis draw an ogive of the above distribution. Use the graph to estimate the following:

(i) the median

(ii) lower Quartile

(iii) if above 158 cm is considered as the tall boys of the class. Find the number of boys in the class who are tall.

Comments of Examiners

(a) A number of candidates were unable to form the equations with given conditions. Some candidates, without using given conditions, guessed the series and identified the values of 'a' and 'd'. There were a few candidates who did not know the formula for summation, who simply surmised the series up to 8 terms and added them to find the sum.

(b) Following errors were observed in this question:

- The last cumulative frequency did not tally with the total of the given distribution.
- Some candidates chose incorrect scale.
- Perpendicular lines were not dropped to find the values from the ogive.
- The ogive was plotted with respect to lower boundaries instead of upper boundaries.
- Ruler was used to draw the graph instead of a freehand curve.
- Kink was not shown on the graph sheet.

Suggestions for teachers

- Explain arithmetic progression and geometric progression comprehensively to students and give ample practice on simplification of problems based on both types of series.
- Explain the concept of kink clearly to students. Also give more practice in ogive using graph sheet.

MARKING SCHEME	
Question 11	
(a)	Let the first term be 'a' and the common difference d. $T_n = a + (n-1)d$ $\therefore T_4 = a + (4-1)d$, $T_{15} = a + (15-1)d$ $22 = a + 3d$ $66 = a + 14d$ $a + 14d = 66$ and $a + 3d = 22$ Solving $a = 10$, $d = 4$ $S_n = \frac{n}{2}[2a + (n-1)d$ $S_8 = \frac{8}{2}[2 \times 10 + (8-1)4$ $= 4[20 + 28]$ $\therefore S_8 = 192$

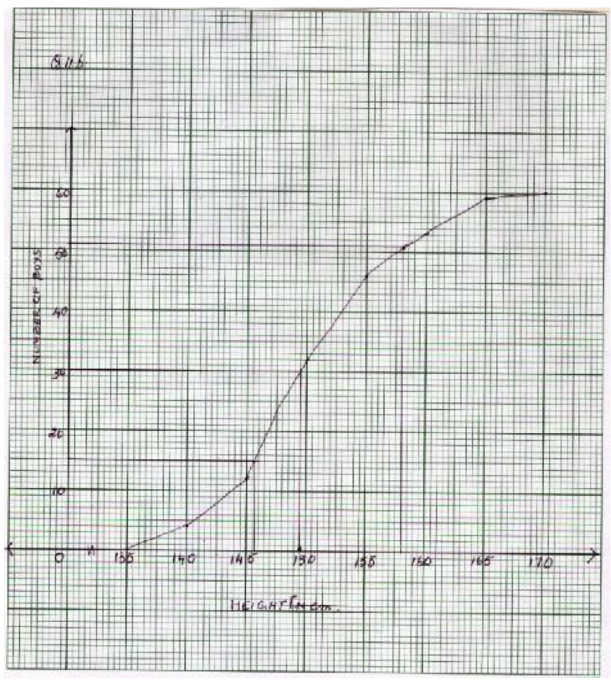
(b)

Height n cm	No. of boys	*cf*
135 – 140	4	4
140 – 145	8	12
145 – 150	20	32
150 – 155	14	46
155 – 160	7	53
160 – 165	6	59
165 – 170	1	60

(i) Median = 150 (±1)

(ii) Q_1 = 146 (±1)

(iii) 60 – 51= 9 boys



Note: For questions having more than one correct answer/solution, alternate correct answers/solutions, apart from those given in the marking scheme, have also been accepted.

GENERAL COMMENTS

Topics found difficult/ confusing by candidates

- Arithmetic Progression and Geometric Progression.
- Shares and Dividend.
- Geometry based problems using properties of circle and similar triangles.
- Geometrical Constructions.
- Section formula.
- Trigonometrical Identities and Heights and Distances.
- Properties of Ratio and Proportion.
- Approximation: to given significant figures or to nearest whole number.
- Factorization in various problems.
- Maps and models.
- Maturity value and interest in Banking sums.
- Use of Remainder and Factor Theorem.
- Forming correct equation in Quadratic word problem.
- Inequation solving and representing solution on number line.

Suggestions for candidates

- Utilize the reading time to make the right choice of question and to be thorough with the given data.
- Practise approximation like significant figures, rounding off to a certain place of decimal or nearest whole number extensively.
- Practise plotting graphs using the correct scale, reading values/interpretation from graph.
- Clearly show the traces of geometrical constructions.
- Give reasons while working out Geometry based problems.
- Practise trigonometric basic identities comprehensively.
- Practise the concepts of Coordinate Geometry- section formula, slope of a parallel/perpendicular line, equation of a line.
- Concepts of Arithmetic Progression(AP) and Geometric Progression(GP) must be done meticulously.
- Use Mathematical tables to find square roots and ratios other than that of standard angles.
- All steps of working including rough work must be clearly shown on same answer page.
- Study the entire syllabus completely and revise from time to time.
- Revise the concepts learnt in Class IX and integrated with the Class X syllabus.
- Develop logical and reasoning skills to have a clear understanding of the concepts.